

FIVE YEAR REVIEW REPORT

Second Five Year Review Report for Wamchem Superfund Site Beaufort, Beaufort County, South Carolina

**Prepared by
U.S. Environmental Protection Agency, Region 4
Atlanta, Georgia**

10114892



FIVE YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Wamchem		
EPA ID: SCD 037 405 362		
Region: 4	State: South Carolina	City/County: Beaufort, Beaufort County
SITE STATUS		
NPL status: Final		
Remediation status: Operating		
Multiple OUs? No	Construction completion date: 06/26/1997	
Has site been put into reuse? No		
REVIEW STATUS		
Lead agency: EPA		
Author: Terry L. Tanner		Author affiliation: U.S. EPA Region 4
Author title: Remedial Project Manager		
Review period: 02/18/2004 - 04/30/2004		
Date of site inspection: 04/15/2003		
Type of review: (Post-SARA) Policy		
Review number or successive: Second Five Year Review		
Triggering action / date: First Five Year Review 04/06/99		
Due Date: 04/06/2004		
Issues: <ol style="list-style-type: none"> 1. Increase in contaminant concentrations for wells RW-4/4R and RW. 2. Estimated time frame needed for the existing groundwater recovery system to meet the cleanup goals outlined in the ROD. 3. Potential for COCs to discharge into McCalleys Creek at concentrations above current AWQC values. 		

Recommendations and Follow-up Actions:

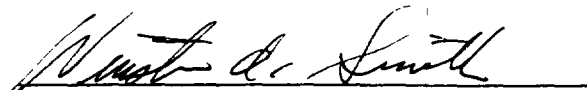
1. Determine why the contaminant concentrations are increasing in RW-4/4R and RW-5/5R, and how the increasing concentrations will impact the effectiveness of the existing groundwater recovery.
2. Determine the time frame necessary for the existing groundwater recovery system to meet the cleanup goals outlined in the ROD, and evaluate optimization methods for increasing the efficiency of this system, and other viable cleanup technologies.
3. Verify that no COCs are discharging into McCalleys Creek at concentrations above current AWQC values.

Protectiveness Statement:

The remedy at the Wamchem Site currently protects human health and the environment because the groundwater recovery system is capturing the contaminated groundwater, and there is no current exposure under existing site conditions. However, in order for the remedy to be protective in the long-term, the actions listed in Section 9 of this Five Year Review Report need to be taken.

Other comments:

Because the Site remedy will continue for more than five years, and contaminated groundwater remains at the Site, a third Five Year Review will be completed five (5) years from the date of this report, which will be April 30, 2009.



**Winston A. Smith, Director
Waste Management Division
U.S. EPA, Region 4**

4/29/04
Date

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I Introduction

General

During February through April 2004, the U.S. Environmental Protection Agency, Region 4 (EPA), conducted a Five Year Review of the Superfund remedy implemented at the Wamchem Site ("the Site") located in Beaufort, Beaufort County, South Carolina. This report documents the results of that review. This is the second Five-Year Review for the site.

Authority

EPA is preparing this report in accordance with its policy set forth in the National Oil and Hazardous Substance Contingency Plan (NCP), the regulation which implements the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), known as Superfund. CERCLA requires that periodic reviews be conducted, at least every five years, at sites where hazardous substances pollutants or contaminants remain onsite above levels that would allow for unlimited use and unrestricted exposure. Section 300.430 (f) (4) (ii) of the NCP further interprets the requirement to apply to all sites for which implementation of all remedial actions will not leave hazardous substances, pollutants or contaminants onsite at such levels, but the remedial actions will require more than five years to complete. Completion of the remedy at this site will require more than five years. The first Five-Year Review for this site was completed in April 1999.

Purpose

The purpose of a Five-Year Review is to determine whether the remedial action at a site remains protective of human health and the environment. The methods, findings and conclusions of reviews are documented in Five-Year Review Reports. In addition, any issues identified during the review are presented, along with recommendations to address these issues.

Site Remedy

A five well groundwater pump-and-treat system was constructed during 1996 and has been in operation since September 1996. The 1988 Site Record of Decision (ROD) also called for treatment of contaminated soil. The soil remedial action was completed in 1993. The groundwater pump-and-treat system is the only currently-active component of the Site remedy.

Five-Year Review Roles

EPA is the lead agency for this Five Year Review. The State of South Carolina, represented by

the SC Department of Health and Environmental Control (SC DHEC), serves as the support agency under Superfund and has provided review and comments on this document. Since the Site is Enforcement Lead, EPA is responsible for overseeing the Remedial Actions performed by Springs Industries who is the responsible party for this Site. Springs Industries is also responsible for operating and maintaining the pump-and-treat system. The figures and tables presented in this Five Year Review are taken from Springs' Quarterly/Annual O&M reports.

II Site Chronology

The following table highlights key dates in the history of the Site.

Table 1 Site Chronology	
Event	Date
EPA Discovery	June 1981
Listing on NPL	September 1984
ROD signature (RI/FS complete)	June 1988
Consent Decree Signed	January 1990
Remedial Design Completed	December 1992
Remedial Action for soil completed	August 1993
Groundwater recovery system operational	September 1996
Preliminary Close-Out Report	September 1997
First Five-Year Review	April 1999

III Background

Site Location and Description

The Wamchem Inc. Site is located in Beaufort, Beaufort County, South Carolina, in a rural area north of the City of Beaufort. The Site consists of an approximately 25-acre area that is bounded on the north by a residential property, and to the south by a Marine Corps air station. A salt marsh is located along the eastern boundary of the Site, and U.S. Highway 21 is located along the western boundary of the Site. Figure 1 shows the location and main features at the Site.

Land and Resource Uses

This area of Beaufort is sparsely populated and consists of a mixture of residential, commercial and industrial properties. Five mobile homes and a 10 unit motel are located one mile north of the site on U.S. Highway 21. The nearest surface water body, McCalleys Creek, borders the site to the east. McCalleys Creek is used for recreational fishing and commercial shellfish harvesting. Property development within this area of Beaufort has essentially remained unchanged since the 1990s.

History of Contamination at the Site

The Wamchem facility synthesized intermediate dye products from 1950 through 1982. The plant was originally built by Beaufort Chemical and Research Company which operated the Site until 1972 when the Site was acquired by the M. Lowenstein Corporation. The M. Lowenstein Corporation, which later merged with Springs Industries, Inc. continued operation of the plant until its closure in 1982.

The principle types of syntheses performed consisted of nitrations, catalytic hydrogenations, oxidations, aminations, amidations, esterification, condensations, low pressure reactions, and sulfonations. Based on a 1978 Toxic Substances Control Act (TSCA) inventory performed on this Site the following chemicals were used and/or manufactured at this facility: 3-amino 4-methylbenzamide, 4-aminobenzamide, 3-nitro 4-methylbenzoic acid, 3-nitro 4-methylbenzamide, 4-nitrobenzamide, secondary-butyl nitrobenzene, and 4-nitrobenzoic acid.

Waste handling and treatment at the plant evolved as the plant grew and as waste treatment methods changed. The initial method of handling waste was to discharge liquid wastes to a drainage ditch, which led to a pair of small, unlined holding ponds. This ditch was later extended to a point of discharge into the marsh. The ditch and small ponds were replaced by a single unlined holding pond and waste lagoon by 1972. These were then replaced with two spray fields and a concrete-lined holding pond in 1975. Later, a solvent recovery and recycling operation was added.

Sampling investigations performed in 1982 by SC DHEC and Law Engineering revealed the presence of site related contaminants within the soil and groundwater. Based on these results, EPA placed the Site on the National Priorities List (NPL) on September 21, 1984.

Basis for Taking Action

On April 16, 1986 EPA entered into a AOC with M. Lowenstein to perform a Remedial Investigation (RI). The results of the RI indicated that soil in the vicinity of the former holding pond was contaminated with volatile and semi-volatile compounds, specifically Acetone, Benzene, 1,2-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4-Dinitrotoluene, and Naphthalene.

Analysis of the surface water samples collected from McCalley's Creek did not reveal the presence of any contaminants in the surface water. However, sediment samples collected adjacent to the site in McCalley's Creek revealed the presence of methylene chloride, benzene, chlorobenzene 1,2-Dichlorobenzene, 1,4-Dichlorobenzene, and Pyrene.

The groundwater investigation performed during the RI included an evaluation of the water table aquifer and the Floridan aquifer. The results of the groundwater investigation indicated that the water table aquifer was contaminated with Methylene Chloride, Benzene, Chlorobenzene, 1,4-Dichlorobenzene, 1,2-Dichlorobenzene, 2,4-Dinitrotoluene, Naphthalene, Toluene, 1,2,4-Trichlorobenzene, and Xylene. The wells located in the water table aquifer adjacent to the production area and the former holding pond revealed the highest levels of contamination. Analysis of the groundwater collected from the wells installed within the Floridan Aquifer did not reveal the presence of any volatile or semi-volatile compounds.

Oysters samples were also collected from McCalley's Creek and analyzed for Acetone, Benzene, 1,2-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4-Dinitrotoluene, Naphthalene, Toluene, 1,2,4-Trichlorobenzene, and Xylene. None of these compounds were detected in the oyster samples.

The Remedial Investigation (RI) was completed on April 21, 1987. The results of the RI revealed that soil and groundwater contamination were present on-site at concentrations which presented unacceptable risk to human health and the environment. The pathways included exposure to contaminated groundwater through both dermal adsorption and ingestion. The concentration of contaminants in soil was such that leaching to groundwater also presented an unacceptable risk and would therefore require remediation.

IV Remedial Action

Remedy Selection

A Record of Decision was issued on June 30, 1988, which outlined low temperature thermal desorption for soils (approximately 2000 cubic yards) and groundwater recovery followed by air stripping for contaminated groundwater. The treated groundwater would be discharged to McCalley's Creek under an NPDES permit.

Although the Record of Decision for this site did not specifically list any remedial action objectives for this site, they could readily be summarized within the following actions: 1) eliminate or minimize the threat posed to public health and the environment from current and/or future migration of hazardous substances in the groundwater; and 2) reduce the mobility, toxicity and/or volume of hazardous substances at the Site.

The cleanup goals for soil were based on their potential for leaching to groundwater and are listed in Table 2. The cleanup goals for groundwater were based upon 1988 USEPA Ambient Water Quality Criteria (AWQC) for protection of salt water aquatic life. The groundwater cleanup goals were set to AWQC values because the water table aquifer at this site discharges

into McCalleys Creek. This creek is a habitat for the Loggerhead Turtle (a Federally Listed Threatened Species), a species which has been sighted in McCalleys Creek.

**TABLE 2
CLEANUP GOALS
WAMCHEM SUPERFUND SITE**

Soils (mg/kg)		Groundwater (mg/l)	
Acetone	97.8	Acetone	1000
Benzene	2.43	Benzene	0.70
1,2-Dichlorobenzene	33.4	1,2-Dichlorobenzene	1.97
1,4-Dichlorobenzene	38.1	1,4-Dichlorobenzene	1.97
2,4-Dinitrotoluene	3.62	2,4-Dinitrotoluene	0.37
Naphthalene	74.6	Naphthalene	2.35
Toluene	34.5	Toluene	5.00
1,2,4-Trichlorobenzene	4.23	1,2,4-Trichlorobenzene	0.129
Total Xylenes	67.6	Total Xylenes	2.0

The selected remedy established clean-up levels for contaminated soils and groundwater based upon risk factors and AWQC considerations. The selected remedy was designed to eliminate the principal threat posed to human health and the environment by preventing direct exposure to contaminated soil and groundwater.

Remedy Implementation

Springs Industries (PRP) entered into a Consent Decree with EPA on January 17, 1990, to perform the Remedial Design/Remedial Action (RD/RA). The Remedial Design Reports for soil and groundwater were approved on December 4, 1992, and July 27, 1995, respectively. Remedial action on the soils began on June 25, 1993 and was completed on August 11, 1993. A total of 2,669 tons of soil were excavated from the area adjacent to the former holding pond. The excavated soil was processed on-site by Four Seasons Industrial Services via a mobile thermal desorption unit. The contaminated soils were excavated, processed within the mobile unit, and analyzed to assure that the processed soils met the clean up goals established in the ROD. Confirmation sampling was performed within the excavation areas.

Analysis for both the processed soils from the thermal desorption unit and from confirmation

samples from the excavation areas revealed that contaminant concentrations met the cleanup goals established for the Site. The processed soils were backfilled in the excavation area, compacted, and the area covered with topsoil and seeded.

Construction of the groundwater pump and treatment system began on February 5, 1996. A construction completion inspection was then performed on May 1, 1996. During this inspection minor items which needed repair were noted in a punch list and submitted to Springs in writing on May 3, 1996. Following startup of the system later that same month, excessive erosion was noted at the effluent outfall at McCalleys Creek. On June 3, 1996, Springs applied for a permit to modify the outfall pipe via the addition of a diffuser head, installation of additional rip-rap, and sheet piling to support the rip-rap. The modifications were completed during August 1996 and the system began operating on September 25, 1996.

System Operations and Maintenance

After an initial startup period during the summer of 1996, the groundwater pump and treatment system became fully operational in September 1996. As a requirement of the NPDES permit, effluent samples were collected from the treatment system and analyzed for acute and chronic toxicity testing. The effluent samples collected for October and November 1996 failed both the acute and chronic bioassays. Based on the NPDES permit requirements Springs drafted a Toxicity Evaluation Plan to evaluate the specific causes of these toxicity failures. This draft Toxicity Plan was submitted to EPA on January 21, 1997. Meanwhile the recovery rates in several of the recovery wells began to decline. With possible concerns over the long-term impact this decline would have on maintaining the necessary groundwater capture, Springs requested a temporary shut down of the recovery system on March 18, 1997, to evaluate the source of the declining recovery rates, restore recovery rates to existing parameters, and resolve the toxicity per NPDES requirements.

Springs Industries submitted a Recovery Well Replacement Work Plan to EPA on May 2, 1997, to evaluate the declining rates, and if necessary, present alternate well installation methods. The source of the declining recovery rates was eventually linked to the well construction materials, specifically the use of PVC slotted well screens (6.6 square inches of open area per linear foot of screen) rather than continuous wire wrapped screens (25 square inches of open area per linear foot of screen). The initial installation consisted of a 14" diameter bore hole created by using bentonite mud drilling fluid which may have further exacerbated the poor recovery volumes. All five recovery wells were then replaced with wire wrapped screens installed in 11 inch boreholes utilizing mud rotary drilling methods. These modifications were completed on June 26, 1997.

Toxicity testing was then resumed following the modifications to the recovery system. At this same time Springs also petitioned the State to modify the existing toxicity test for NPDES permits by using the organism *Mysidopsis bahia* instead of *Ceriodaphnia dubia* per EPA's recent guidance titled "Methods for Measuring Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms", 4th edition, EPA/600/4-90/027F.

Following the modifications of the recovery system on June 26, 1997, toxicity testing was resumed per the NPDES permit. Results from October and November 1997 testing each exhibited one failed round for acute toxicity testing. Additional testing conducted on subsequent weeks showed no acute toxicity to test organisms.

During the month of December, one round of samples failed chronic toxicity testing. Here again subsequent sampling showed no acute toxicity to the test organisms. During the early part of 1998 (January, February, & March) two additional failures for acute toxicity occurred during the month of February. Test results during April, May, and June of 1998 exhibited no failures for acute or chronic toxicity testing.

Daily inspections as required under the NPDES permit are performed by E.A. Services, a local contracting firm. E.A. Services also performs the weekly monitoring of effluent from the treatment system. The analytical results, in addition to O&M activities, were reported to EPA on a quarterly basis for the first five years of the operating groundwater pump and treatment system (1996 through 2001). The frequency of monitoring and reporting has since been reduced and the results are now reported to EPA on an annual basis. Groundwater sampling is performed by Environmental Resource Management (ERM) with the samples submitted to Shealy Environmental Services in Columbia, SC, for analysis. Operations & Maintenance activities for the groundwater recovery and treatment system are performed on a monthly basis by Handex, Inc.

V Progress Since the Last Five Year Review

The last Five Year Review for this Site included a Statement of Protectiveness which stated that *"The cleanup goals levels presented in the 1988 ROD are primarily protective of ecological receptors"*. The last Five Year Review also proposed changing the cleanup levels to reflect the MCLs, and monitoring McCalley's Creek for COCs. The following sections identify the issues that were brought to light during the process of changing the cleanup levels, and discusses how these issues were addressed.

Groundwater Concentrations

The first Five Year Review was completed on April 6, 1999, which was approximately four years after the groundwater extraction and treatment system began operating. A review of the groundwater data shows that the majority of the COCs have been decreasing in concentration, and/or have current concentrations of COCs which are below their corresponding cleanup goals. However, other COCs have been increasing or remaining at a relatively constant concentration above their corresponding cleanup goals. A detailed discussion of the data is presented in Section VI of this report.

The data suggest that the majority of the plume remains on-site and the remedy is functioning as designed to achieve the groundwater cleanup goals. However, the elevated and/or increasing

concentrations of COCs above the cleanup goals, and the proximity of the plume to the creek suggest the need to evaluate alternative methods to enhance the performance of the recovery system.

Toxicity Testing

Because the treated groundwater is discharged to McCalley's Creek, this site operates under an NPDES permit to monitor the quality of the effluent being discharged into the creek. Monthly acute and chronic toxicity testing, in addition to monitoring the concentrations of select COCs, has been a requirement of the NPDES permit since 1996. Specific COCs monitored under the permit initially consisted of Benzene, Toluene, Total Xylene, Phenol, 1,4-Dichlorobenzene, 2,4-Dinitrotoluene, Naphthalene, and 1,2,4-Trichlorobenzene.

Based on the overall performance of the monitoring, the NPDES permit was renewed on September 21, 2000, and the monitoring requirements reduced to consist of analysis for 1,2,4-Trichlorobenzene and pH twice per month. The daily maximum discharge limit for 1,2,4-Trichlorobenzene was reduced from 0.734 to 0.275 lbs/day, and the effluent toxicity testing was also reduced to one 48-hour static acute toxicity test per year.

The NPDES monitoring results are submitted to SC DHEC Bureau of Water on a monthly basis using a Discharge Monitoring Report form. A portion of these results, the analytical data for COCs and average daily flow rates on both the influent and effluent, are also reported to EPA in the Groundwater Monitoring and Operations & Maintenance Reports. According to an interview with Harshala Chandrashekar, Environmental Health Manager for SC DHEC, the quality of the discharge effluent has remained in compliance with the NPDES permit limitations for the reporting period from September 2000 through December 2003. The December 2003 report was the most recent report received as of the writing of this Five Year Review.

ARARs Review

During the previous Five Year Review, the groundwater cleanup goals were discussed at length primarily because the groundwater cleanup goals established in the ROD were based on the 1988 Ambient Water Quality Criteria Values rather than MCLs. The previous Five-Year Review recommended changing the cleanup goals to MCLs which would meet the ARAR requirement for restoring the site's groundwater to MCLs, yet still remain protective to ecological receptors within McCalley's Creek.

Concurrent with this change in cleanup goals, a groundwater mixing zone permit application was filed by Springs Industries. Obtaining a mixing zone permit would essentially modify the area of the plume to be treated. This would free up a portion of the resources currently used at the site for use on other specific areas of the plume. This would maximize the effectiveness of the treatment and theoretically shorten the cleanup time-frame.

The groundwater quality of the shallow aquifer within portions of the plume where the site-

specific plume is located would not be considered potable due to the total dissolved solids content. Therefore the application of MCLs as a ARAR would not be appropriate for this particular portion of the shallow aquifer and be no more effective than utilizing the existing cleanup goals. Maintaining the existing cleanup goals would be justifiable because, if left untreated, the plume would discharge into McCalleys Creek and pose a threat to aquatic receptors within this creek.

A review of the draft mixing zone permit for this site also suggested that little benefit would have been gained through obtaining this permit. Specifically the compliance points identified within the draft mixing zone permit would have remained at a location near the line of existing recovery wells and would have been similar in concentration levels to current cleanup goals.

TABLE 3 WAMCHEM SUPERFUND SITE (mg/l)			
Contaminant	ROD	MCL	Current AWQC
Acetone	1000*	N/A	N/A
Benzene	0.70	0.005	0.051
1,2-Dichlorobenzene	1.97	0.60	17
1,4-Dichlorobenzene	1.97	0.075	2.6
2,4-Dinitrotoluene	0.37	N/A	0.0034
Naphthalene	2.35	1.50	N/A
Toluene	5.00	1.00	200
1,2,4-Trichlorobenzene	0.129*	0.07	0.94
Total Xylenes	2.0	10.0	N/A
*No AWQC existed for this compound in 1988. Values listed in the ROD were based upon a general aquatic rating obtained by the Registry of Toxic Effects of Chemical Substances, 1982. N/A -No MCL nor AWQC value currently exist for these compounds.			

The AWQC values are the only Chemical-Specific ARAR known to be applicable to this site. No other ARARs including Action-Specific or Location-Specific were discovered during this review which could be applied to this site.

VI Five Year Review Process

Components of the Review

In accordance with guidance, a review team was established to review and comment on the Five Year Review as summarized in this document. Members are listed below:

<u>Name</u>	<u>Affiliation</u>	<u>Role</u>
Terry L. Tanner	EPA Region 4, Waste Management Division	Project Manager (PM), Five Year Review preparation
Minda Johnson	SCDHEC, Bureau of Land and Waste Management, Columbia SC	State review (Support Agency) role under CERCLA
Keisha Long	SCDHEC, Bureau of Land and Waste Management, Columbia SC	State review (Support Agency) role under CERCLA
Stephanie Y. Brown	EPA, Waste Management Division	Community Involvement

A draft version of this Five Year Review Report was circulated to review team members during March and April 2004. All comments generated from their review have been addressed and incorporated herein.

The most recent Site Inspection was performed on April 15, 2003. Although this last inspection was not specifically intended to support this Five Year Review, the information gathered during this visit was used to complete the inspection check list for this Site. The EPA Project Manager and the SC DHEC Project Manager have visited the Site on many occasions so there was no need for re-familiarization of team members to the Site.

Community Notification and Involvement

This site is located in a rural, sparsely populated area north of the city of Beaufort, SC. This area is serviced by the Island Packet Newspaper. Following approval of this Five-Year Review, EPA will notify the community through a newspaper ad that the Five-Year Review report for the Wamchem Site is complete, and that the results of the review and the report are available to the public at the Site information repository located at the Beaufort County Library, located in Beaufort, South Carolina. A copy of this report will also be placed in the Administrative Record file at EPA and at the SC DHEC office.

Site Inspection

The most recent site inspection was conducted on April 15, 2003. The purpose of the inspection was to assess the operation and function of the groundwater recovery system. The inspection team consisted of Mr. Terry Tanner from EPA and Mr. Robert Gossett from Environmental Resource Management (ERM). The completed Five-Year Review Site Inspection Checklist is presented in Appendix A.

The site was well maintained with the equipment functioning as designed. There were no obvious equipment malfunctions and all gauges, pumps and blowers were operational. Maintenance of the vegetation appears to be performed on a regular basis with the grass and shrubs well trimmed therefore all equipment including the wells and NPDES discharge point were easily accessible by foot. The concrete pad which houses the collection sump, pumps and air stripping tower was free of debris and appears to have been repainted within the previous year.

Data Review

This Five Year Review consisted of a review of the relevant documents including all Operations & Maintenance records and groundwater monitoring data. Because the remedy was designed to cleanup contaminated groundwater using extraction well technology, groundwater monitoring has been conducted at this Site for the past seven years under operating conditions. Specific monitoring components consisted of groundwater elevations, COC concentrations, Total Dissolved Solids, influent and effluent concentration of selected COCs, monthly total flow volumes, and select inorganic data used to evaluate groundwater chemistry (calcium, magnesium, potassium, sodium, bicarbonate, chloride, and sulfate).

Monitoring reports have been generated by Springs Industries and submitted to EPA for the past seven years which present the monitoring data, statistical analysis on the groundwater chemistry, groundwater hydraulics, discuss the analytical results, and the effectiveness of the groundwater capture system.

A review of the concentration of COCs in groundwater samples show that for some of the wells (RW-1/1R, RW-2/2R, RW-3/3R, RI-5) the majority of the COCs have generally been decreasing in concentration, and/or have current concentrations of COCs which are below their corresponding cleanup goals. Well RW-5/5R would also fall within this category with the exception of 1,2,4-Trichlorobenzene (510 ug/L) which has been increasing in concentration since February 1998 and presently exceeds its cleanup goal of 130 ug/L.

Other COCs have been increasing or remaining at a relatively constant concentrations above their corresponding cleanup goals within two of these same wells. These wells include RW-4/4R (1,2 - Dichlorobenzene, 1,2,4-Trichlorobenzene and 2,4-Dinitrotoluene), and RW-5 (1,2,4-

Trichlorobenzene). The isoconcentration map for 1,2-Dichlorobenzene suggests that a small portion of the plume is encroaching upon McCalley's Creek.

In general the data suggest that the majority of the plume remains on-site and the remedy is currently functioning as designed to achieve the groundwater cleanup goals. However, the elevated and/or increasing concentrations of COCs above the cleanup goals, and the proximity of the plume to the creek suggest the need to evaluate alternative methods to enhance the performance of the recovery system. If the rising concentrations of COCs are left unchecked, the contaminant mass could exceed the capacity of the current pump and treatment system and thereby compromise the system's ability to achieve the groundwater cleanup goals.

Since these findings affect the evaluation of the operational effectiveness and overall performance, they are considered further in section VII below. Optimization work will be needed to identify the most effective measures to optimize performance of the pump and treatment system.

VII Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

In general the remedy is functioning as intended by the decision documents. To provide a detailed response, the following paragraphs consider and expand upon the evaluations and findings presented in the semi-annual reports.

The system operations criteria include issues of reliability as well as the effectiveness of current procedures required to operate the pump and treatment system. The Groundwater Monitoring Reports provide a brief summary of these issues under the Operations and Maintenance section of these reports. A detailed summary of these activities is also included as Appendix C within these same reports.

Each summary section of the O&M Monitoring Report details the specific maintenance actions performed during the reporting time period. Review of past reports indicates that while there have been equipment and consequent operational problems, these are not unusual for pump-and-treat systems such as the system operating at the Wamchem Site. In the early operational period associated with this second Five-Year review (1999-2000), problems with fouled lines leading to the hydrocarbon monitoring unit resulted in tripped high level alarms and shut down of the recovery system. This monitoring unit measures real-time total hydrocarbon levels in the effluent discharge stream and shuts down the recovery system if elevated hydrocarbon levels are detected in the effluent stream. The maintenance interval for the inlet tubing leading to the monitoring unit was eventually increased to a weekly basis to combat the fouling, however the inlet lines still remained susceptible to fouling. Following a review of the analytical data for COCs present in effluent concentration from July 1997 through September 1999, EPA agreed with Spring's request to remove the hydrocarbon monitoring unit from the effluent stream on January 4, 2001. The low levels of COCs present in the effluent stream observed over the entire operational

history of the system did not justify the continued usage of the hydrocarbon monitoring unit for this system.

There have also been the usual electrical glitches and pump failures, although these were mostly prior to 2000. As shown in Appendix D of the 2003 Annual O&M Monitoring Report, the treatment system maintained an average treatment rate of more than 43,900 gallons of contaminated groundwater per day. Review of this and past monitoring reports indicates that, with occasional exceptions, system pumping rates and overall pumping efficiencies have been consistent and uninfluenced by short-term problems at individual wells.

Opportunities for system optimization were observed during this review process. The monitoring well network provides sufficient data to assess the progress of the extraction system. There is some concern with the groundwater extraction system and its effect on the plume in the vicinity of RW-4/4R and RW-5/5R. Concentrations of COCs in most of the wells have presented a downward trend. However for other COCs the concentrations have remained stable within the last five years, with some lacking any downward trend in contaminant concentrations. This may be an indication that the groundwater plume is not effectively influenced by the existing extraction well network after seven years of operation.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection, still valid?

The exposure assumptions for this site, specifically the exposure of aquatic life to contaminated groundwater discharging into McCalleys Creek) remains a valid exposure assumption. Land use in the Site area, and the exposure scenarios considered within in the 1988 ROD have not changed since 1988.

In regards to the cleanup levels, EPA has made changes to the AWQC values initially used to establish the cleanup goals set in the 1988 ROD, but these changes alone would not justify revising the existing cleanup levels established for this site. Therefore the AWQC values are still valid. This would hold true even for the AWQC values which have been revised to more stringent requirements since the 1988 ROD.

To provide some perspective on this issue, consider that the direct application of the 1988 AWQC values as groundwater cleanup values represent a conservative approach because the dilution of groundwater with surface water was not factored into these values. Using a dilution factor of 75.7 for McCalleys Creek, a value obtained from the Site's NPDES permit, the calculations show that the resulting concentrations of COC in surface water would not be expected to exceed EPA's current AWQC values (see Table 3).

Furthermore, the concentration of 1,2,4-Trichlorobenzene in the effluent typically averages less than 6 ug/L although, on occasion, peaks of 74 ug/L (August 6, 2002) and 62 ug/L (January 4, 2003) have been observed in the effluent. These values remain well below the current AWQC for 1,2,4-Trichlorobenzene (940 ug/L).

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

Results of the groundwater monitoring since 1996 have demonstrated that there are some performance issues associated with the groundwater recovery system that should be addressed. The data suggest that the majority of the plume remains on-site and the remedy is currently functioning as designed to achieve the groundwater cleanup goals. However, the elevated and/or increasing concentrations of COCs above the cleanup goals, and the proximity of the plume to the creek suggest the need to evaluate methods to enhance the performance of the recovery system. If the rising concentrations of COCs are left unchecked, the contaminant mass could exceed the capacity of the current pump and treatment system and thereby compromise the system's ability to achieve the groundwater cleanup goals. In order to ensure long-term protectiveness, optimization work will be needed to identify the most effective measures to enhance the performance of the pump and treatment system.

Technical Assessment Summary

There have been no changes in the physical condition of the site, and no significant changes in risk criteria that would call into question the protectiveness of the remedy. A review of the Site remedy indicates that the groundwater pump and treatment system is operating as originally designed, but needs improvement in its efficiency. Specifically there is some concern over the effectiveness of the groundwater extraction system and its impact on the plume in the vicinity of RW-4/4R and RW-5/5R. Some of the concentrations of COCs have remained stable within the last five years and lack any downward trend, while other COCs have demonstrated an increase in contaminant concentrations. This may be an indication that a portion of the groundwater plume is not effectively influenced by the existing extraction well network.

VIII Issues

Table 6 Five Year Review Issues		
Issues	Affects Current Protectiveness	Affects Future Protectiveness
Increase in contaminant concentrations for wells RW-4/4R and RW-5/5R	No	Yes
Time frame necessary for the existing groundwater recovery system to meet the cleanup goals outlined in the ROD.	No	No

Potential for COCs to discharge into McCalleys Creek at concentrations above current AWQC values.	No	Yes
---	----	-----

IX Recommendations and Follow-up Actions

To achieve long-term protectiveness, the issues listed above will require that a series of followup actions be implemented. The actions and planned milestones are summarized below.

Table 7 Recommendations and Milestones				
Recommendation	Responsible Party	Milestone	Affects Protectiveness? (Y/N)	
			Current	Future
Determine why the contaminant concentrations are increasing in RW-4/4R and RW-5/5R, and how the increasing concentrations will impact the effectiveness of the existing groundwater recovery.	Springs Ind.	April 2005	No	Yes
Determine the time frame necessary for the existing groundwater recovery system to meet the cleanup goals outlined in the ROD, and evaluate optimization methods for increasing the efficiency of this system, and other viable cleanup technologies.	Springs Ind.	April 2005	No	No
Verify that no COCs are discharging into McCalleys Creek at concentrations above current AWQC values.	Springs Ind.	April 2005	No	Yes

X Protectiveness Statement

The remedy at the Wamchem Site currently protects human health and the environment. Monitoring data indicate that the pump and treatment system is capturing the contaminated groundwater and there is no current exposure pathway for human or ecological receptors that is not adequately addressed through the remedy implemented at this Site.

However, in order for the remedy to be protective in the long-term, the actions listed in Section IX above need to be taken. The actions include a determination as to why the contaminant concentrations are increasing at the Site and how these increases will impact the effectiveness of the recovery system. Additional monitoring of McCalley's Creek should be performed to ensure that no COCs are discharging into the creek at concentrations which would result in an exceedance of any current AWQC values.

XI Next Review

Because the Site remedy will continue for more than five years, and contaminated groundwater remains at the Site, a third Five Year Review will be completed five (5) years from the date of this report, which will be April 26, 2009.

Appendix A

Five Year Review
Site Inspection Checklist

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION													
Site name: <u>WAMCHEM</u>	Date of inspection: <u>4/15/03</u>												
Location and Region: <u>BEAUFORT, SC (REGION IV)</u>	EPA ID: <u>SCD 037 405 362</u>												
Agency, office, or company leading the five-year review: <u>EPA REGION IV</u>	Weather/temperature: <u>CLEAR SKIES TEMP MID 70's.</u>												
Remedy Includes (Check all that apply) <table style="width: 100%; border: none;"> <tr> <td><input type="checkbox"/> Landfill cover/containment</td> <td><input type="checkbox"/> Monitored natural attenuation</td> </tr> <tr> <td><input type="checkbox"/> Access controls</td> <td><input type="checkbox"/> Groundwater containment</td> </tr> <tr> <td><input type="checkbox"/> Institutional controls</td> <td><input type="checkbox"/> Vertical barrier walls</td> </tr> <tr> <td><input checked="" type="checkbox"/> Groundwater pump and treatment</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Surface water collection and treatment</td> <td></td> </tr> <tr> <td colspan="2"><input checked="" type="checkbox"/> Other <u>DISCHARGE TO SURFACE WATER VIA NPDES</u></td> </tr> </table>		<input type="checkbox"/> Landfill cover/containment	<input type="checkbox"/> Monitored natural attenuation	<input type="checkbox"/> Access controls	<input type="checkbox"/> Groundwater containment	<input type="checkbox"/> Institutional controls	<input type="checkbox"/> Vertical barrier walls	<input checked="" type="checkbox"/> Groundwater pump and treatment		<input type="checkbox"/> Surface water collection and treatment		<input checked="" type="checkbox"/> Other <u>DISCHARGE TO SURFACE WATER VIA NPDES</u>	
<input type="checkbox"/> Landfill cover/containment	<input type="checkbox"/> Monitored natural attenuation												
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<input type="checkbox"/> Institutional controls	<input type="checkbox"/> Vertical barrier walls												
<input checked="" type="checkbox"/> Groundwater pump and treatment													
<input type="checkbox"/> Surface water collection and treatment													
<input checked="" type="checkbox"/> Other <u>DISCHARGE TO SURFACE WATER VIA NPDES</u>													
Attachments: <input type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached													
II. INTERVIEWS (Check all that apply)													
1 O&M site manager _____ <table style="width: 100%; border: none; margin-top: 5px;"> <tr> <td style="text-align: center;">Name</td> <td style="text-align: center;">Title</td> <td style="text-align: center;">Date</td> </tr> <tr> <td colspan="3"> Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone no _____ </td> </tr> <tr> <td colspan="3"> Problems, suggestions, <input type="checkbox"/> Report attached _____ </td> </tr> </table>		Name	Title	Date	Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone no _____			Problems, suggestions, <input type="checkbox"/> Report attached _____					
Name	Title	Date											
Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone no _____													
Problems, suggestions, <input type="checkbox"/> Report attached _____													
2 O&M staff <u>ROBERT GOSSETT</u> <u>TECHNICIAN</u> <u>4/15/03</u> <table style="width: 100%; border: none; margin-top: 5px;"> <tr> <td style="text-align: center;">Name</td> <td style="text-align: center;">Title</td> <td style="text-align: center;">Date</td> </tr> <tr> <td colspan="3"> Interviewed <input checked="" type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone no _____ </td> </tr> <tr> <td colspan="3"> Problems, suggestions, <input type="checkbox"/> Report attached _____ </td> </tr> </table>		Name	Title	Date	Interviewed <input checked="" type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone no _____			Problems, suggestions, <input type="checkbox"/> Report attached _____					
Name	Title	Date											
Interviewed <input checked="" type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone no _____													
Problems, suggestions, <input type="checkbox"/> Report attached _____													

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency SC DHEC
Contact KATHA LOUIS PROJECT MANAGER 9/18/03 803/856-4073
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

Agency _____
Contact _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

Agency _____
Contact _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

Agency _____
Contact _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

4. **Other interviews** (optional) ☐ Report attached.

N/A —

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1	O&M Documents <input type="checkbox"/> O&M manual <input type="checkbox"/> As-built drawings <input type="checkbox"/> Maintenance logs Remarks: <i>Records are kept in office of ERM and provided on site during field activities</i>	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
2	Site-Specific Health and Safety Plan <input type="checkbox"/> Contingency plan/emergency response plan Remarks:	<input checked="" type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date	<input type="checkbox"/> N/A <input type="checkbox"/> N/A
3	O&M and OSHA Training Records Remarks: <i>Retained in office at ERM.</i>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input type="checkbox"/> N/A
4	Permits and Service Agreements <input type="checkbox"/> Air discharge permit <input checked="" type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Other permits Remarks:	<input type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
5	Gas Generation Records Remarks:	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
6	Settlement Monument Records Remarks:	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
7	Groundwater Monitoring Records Remarks: <i>Retained in office at ERM.</i>	<input type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A
8	Leachate Extraction Records Remarks:	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
9	Discharge Compliance Records <input type="checkbox"/> Air <input checked="" type="checkbox"/> Water (effluent) Remarks: <i>ERM office</i>	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A <input type="checkbox"/> N/A
10	Daily Access/Security Logs Remarks: <i>Property is secured by through local resident retained to manage the site.</i>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
IV. O&M COSTS				

1	O&M Organization <input type="checkbox"/> State in-house <input type="checkbox"/> PRP in-house <input type="checkbox"/> Federal Facility in-house <input type="checkbox"/> Other _____	<input type="checkbox"/> Contractor for State <input checked="" type="checkbox"/> Contractor for PRP <input type="checkbox"/> Contractor for Federal Facility																																																		
2	O&M Cost Records <input type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> Funding mechanism/agreement in place Original O&M cost estimate <u>\$155,100/YR.</u> <input type="checkbox"/> Breakdown attached <div style="text-align: center;">Total annual cost by year for review period if available</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">From _____</td> <td style="width: 15%;">To _____</td> <td style="width: 20%;">_____</td> <td style="width: 10%; text-align: center;">Total cost</td> <td style="width: 40%;"><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td></td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td>_____</td> <td style="text-align: center;">Total cost</td> <td><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td></td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td>_____</td> <td style="text-align: center;">Total cost</td> <td><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td></td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td>_____</td> <td style="text-align: center;">Total cost</td> <td><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td></td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td>_____</td> <td style="text-align: center;">Total cost</td> <td><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td></td> <td></td> <td></td> </tr> </table>		From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date				From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date				From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date				From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date				From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date			
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3	Unanticipated or Unusually High O&M Costs During Review Period Describe costs and reasons <u>UNKNOWN</u> _____ _____ _____ _____ _____																																																			
V. ACCESS AND INSTITUTIONAL CONTROLS <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A																																																				
A. Fencing																																																				
1	Fencing damaged <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Gates secured <input type="checkbox"/> N/A Remarks <u>SITE IS WELL SECURED</u> _____ _____																																																			
B. Other Access Restrictions																																																				
1	Signs and other security measures <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> N/A Remarks _____ _____ _____																																																			

C. Institutional Controls (ICs)**1. Implementation and enforcement**

Site conditions imply ICs not properly implemented

☐ Yes ☐ No ☒ N/A

Site conditions imply ICs not being fully enforced

☐ Yes ☐ No ☒ N/A

Type of monitoring (e.g., self-reporting, drive by) _____

Frequency _____

Responsible party/agency _____

Contact _____

Name

Title

Date

Phone no.

Reporting is up-to-date

☐ Yes ☐ No ☐ N/A

Reports are verified by the lead agency

☐ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met

☐ Yes ☐ No ☐ N/A

Violations have been reported

☐ Yes ☐ No ☐ N/AOther problems or suggestions: ☐ Report attached**2. Adequacy**☐ ICs are adequate☐ ICs are inadequate☒ N/A

Remarks _____

D. General**1. Vandalism/trespassing**☐ Location shown on site map☒ No vandalism evident

Remarks _____

2. Land use changes on site ☒ N/ARemarks NO CHANGES NOTED**3. Land use changes off site** ☒ N/ARemarks NO CHANGES NOTED**VI. GENERAL SITE CONDITIONS****A. Roads**☒ Applicable☐ N/A**1. Roads damaged**☐ Location shown on site map☐ Roads adequate☒ N/A

Remarks _____

B. Other Site ConditionsRemarks _____

_____**VII. LANDFILL COVERS** ☐ Applicable ☒ N/A**A. Landfill Surface**

1 **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
Areal extent _____ Depth _____
Remarks _____

2 **Cracks** ☐ Location shown on site map ☐ Cracking not evident
Lengths _____ Widths _____ Depths _____
Remarks _____

3 **Erosion** ☐ Location shown on site map ☐ Erosion not evident
Areal extent _____ Depth _____
Remarks _____

4 **Holes** ☐ Location shown on site map ☐ Holes not evident
Areal extent _____ Depth _____
Remarks _____

5 **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
☐ Trees/Shrubs (indicate size and locations on a diagram)
Remarks _____

6 **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
Remarks _____

7 **Bulges** ☐ Location shown on site map ☐ Bulges not evident
Areal extent _____ Height _____
Remarks _____

8	Wet Areas/Water Damage <input type="checkbox"/> Wet areas <input type="checkbox"/> Ponding <input type="checkbox"/> Seeps <input type="checkbox"/> Soft subgrade Remarks _____	<input type="checkbox"/> Wet areas/water damage not evident <input type="checkbox"/> Location shown on site map Areal extent _____ <input type="checkbox"/> Location shown on site map Areal extent _____ <input type="checkbox"/> Location shown on site map Areal extent _____ <input type="checkbox"/> Location shown on site map Areal extent _____
9	Slope Instability <input type="checkbox"/> Slides <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of slope instability Areal extent _____ Remarks _____	
B. Benches <input type="checkbox"/> Applicable <input type="checkbox"/> N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)		
1	Flows Bypass Bench Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay
2	Bench Breached Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay
3	Bench Overtopped Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay
C. Letdown Channels <input type="checkbox"/> Applicable <input type="checkbox"/> N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)		
1	Settlement <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of settlement Areal extent _____ Depth _____ Remarks _____	
2	Material Degradation <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of degradation Material type _____ Areal extent _____ Remarks _____	
3	Erosion <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of erosion Areal extent _____ Depth _____ Remarks _____	
4	Undercutting <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of undercutting Areal extent _____ Depth _____ Remarks _____	

5	Obstructions <input type="checkbox"/> Location shown on site map Size _____ Remarks _____	Type _____ Areal extent _____ <input type="checkbox"/> No obstructions	
6	Excessive Vegetative Growth <input type="checkbox"/> No evidence of excessive growth <input type="checkbox"/> Vegetation in channels does not obstruct flow <input type="checkbox"/> Location shown on site map Remarks _____	Type _____ Areal extent _____	
D. Cover Penetrations <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A			
1	Gas Vents <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> N/A Remarks _____	<input type="checkbox"/> Active <input type="checkbox"/> Passive <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance	
2	Gas Monitoring Probes <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration Remarks _____	<input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A	
3	Monitoring Wells (within surface area of landfill) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration Remarks _____	<input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A	
4	Leachate Extraction Wells <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration Remarks _____	<input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A	
5	Settlement Monuments Remarks _____	<input type="checkbox"/> Located <input type="checkbox"/> Routinely surveyed <input type="checkbox"/> N/A	

E. Gas Collection and Treatment <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A			
1	Gas Treatment Facilities <input type="checkbox"/> Flaring <input type="checkbox"/> Thermal destruction <input type="checkbox"/> Collection for reuse <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____		
2	Gas Collection Wells, Manifolds and Piping <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____		
3	Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings) <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____ _____		
F. Cover Drainage Layer <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A			
1	Outlet Pipes Inspected <input type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks _____ _____		
2	Outlet Rock Inspected <input type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks _____ _____		
G. Detention/Sedimentation Ponds <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A			
1	Siltation Areal extent _____ Depth _____ <input type="checkbox"/> N/A <input type="checkbox"/> Siltation not evident Remarks _____ _____		
2	Erosion Areal extent _____ Depth _____ <input type="checkbox"/> Erosion not evident Remarks _____ _____		
3	Outlet Works <input type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks _____ _____		
4	Dam <input type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks _____ _____		

H. Retaining Walls <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
1	Deformations <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Deformation not evident Horizontal displacement _____ Vertical displacement _____ Rotational displacement _____ Remarks _____	
2	Degradation <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Degradation not evident Remarks _____	
I. Perimeter Ditches/Off-Site Discharge <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A		
1	Siltation <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Siltation not evident Areal extent _____ Depth _____ Remarks _____	
2	Vegetative Growth <input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Vegetation does not impede flow Areal extent _____ Type _____ Remarks _____	
3	Erosion <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Erosion not evident Areal extent _____ Depth _____ Remarks <u>DIFFUSION "HEADED" IN GOOD REPAIR.</u>	
4	Discharge Structure <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks <u>NO PROBLEMS NOTES</u>	
VIII. VERTICAL BARRIER WALLS <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
1	Settlement <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Settlement not evident Areal extent _____ Depth _____ Remarks _____	
2	Performance Monitoring Type of monitoring _____ <input type="checkbox"/> Performance not monitored Frequency _____ <input type="checkbox"/> Evidence of breaching Head differential _____ Remarks _____	

IX. GROUNDWATER/SURFACE WATER REMEDIES <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines <input type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	Pumps, Wellhead Plumbing, and Electrical <input checked="" type="checkbox"/> Good condition <input checked="" type="checkbox"/> All required wells properly operating <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks <u>NO PROBLEMS NOTED/OBSERVED.</u>
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks <u>NO PROBLEMS NOTED</u>
3.	Spare Parts and Equipment <input type="checkbox"/> Readily available <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____
B. Surface Water Collection Structures, Pumps, and Pipelines <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	Collection Structures, Pumps, and Electrical <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____
2.	Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____
3.	Spare Parts and Equipment <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____

C. Treatment System		<input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A
1	Treatment Train (Check components that apply) <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div> <input type="checkbox"/> Metals removal <input checked="" type="checkbox"/> Air stripping <input type="checkbox"/> Filters <input type="checkbox"/> Additive (e.g., chelation agent, flocculent) <input type="checkbox"/> Others </div> <div> <input type="checkbox"/> Oil/water separation <input type="checkbox"/> Carbon adsorbers <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> Sampling ports properly marked and functional <input type="checkbox"/> Sampling/maintenance log displayed and up to date <input type="checkbox"/> Equipment properly identified <input type="checkbox"/> Quantity of groundwater treated annually <input type="checkbox"/> Quantity of surface water treated annually </div> <div> <input type="checkbox"/> Bioremediation </div> </div> <p>Remarks: <u>ALL EQUIPMENT IN GOOD CONDITION AND FUNCTIONING AS DESIGNED.</u></p>	
2	Electrical Enclosures and Panels (properly rated and functional) <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance </div> <p>Remarks: _____</p>	
3	Tanks, Vaults, Storage Vessels <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs Maintenance </div> <p>Remarks: _____</p>	
4	Discharge Structure and Appurtenances <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance </div> <p>Remarks: _____</p>	
5	Treatment Building(s) <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition (esp. roof and doorways) <input type="checkbox"/> Needs repair </div> <p>Remarks: _____</p>	
6	Monitoring Wells (pump and treatment remedy) <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div> <input checked="" type="checkbox"/> Properly secured/locked <input type="checkbox"/> All required wells located </div> <div> <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> Needs Maintenance </div> <div> <input checked="" type="checkbox"/> Routinely sampled <input type="checkbox"/> N/A </div> <div> <input checked="" type="checkbox"/> Good condition </div> </div> <p>Remarks: _____</p>	
D. Monitoring Data		
1	Monitoring Data <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input checked="" type="checkbox"/> Is routinely submitted on time <input checked="" type="checkbox"/> Is of acceptable quality </div>	
2	Monitoring data suggests <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input checked="" type="checkbox"/> Groundwater plume is effectively contained <input type="checkbox"/> Contaminant concentrations are declining </div>	

D. Monitored Natural Attenuation

1

Monitoring Wells (natural attenuation remedy)

☐ Properly secured/locked

☐ Functioning

☐ Routinely sampled

☐ Good condition

☐ All required wells located

☐ Needs Maintenance

☐ N/A

Remarks _____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy is functioning as designed to contain the contaminant plume and reduce contaminant concentrations to meet the clean up goals set in the Record of Decision.

While the majority of contaminants are decreasing in concentration, some of the contaminants remain at steady concentrations and have even increased. Therefore optimization studies are recommended for this system.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The treatment system is well maintained. Short term problems have not adversely impacted the overall performance of the recovery/treatment systems.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future

A few of the contaminant concentrations are increasing and/or not decreasing in concentration levels. If this trend continues the protectiveness of the remedy may be compromised in the future.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy

The groundwater recovery system ~~is~~ would benefit from an optimization study. This will be discussed in the Five Year Review Report.